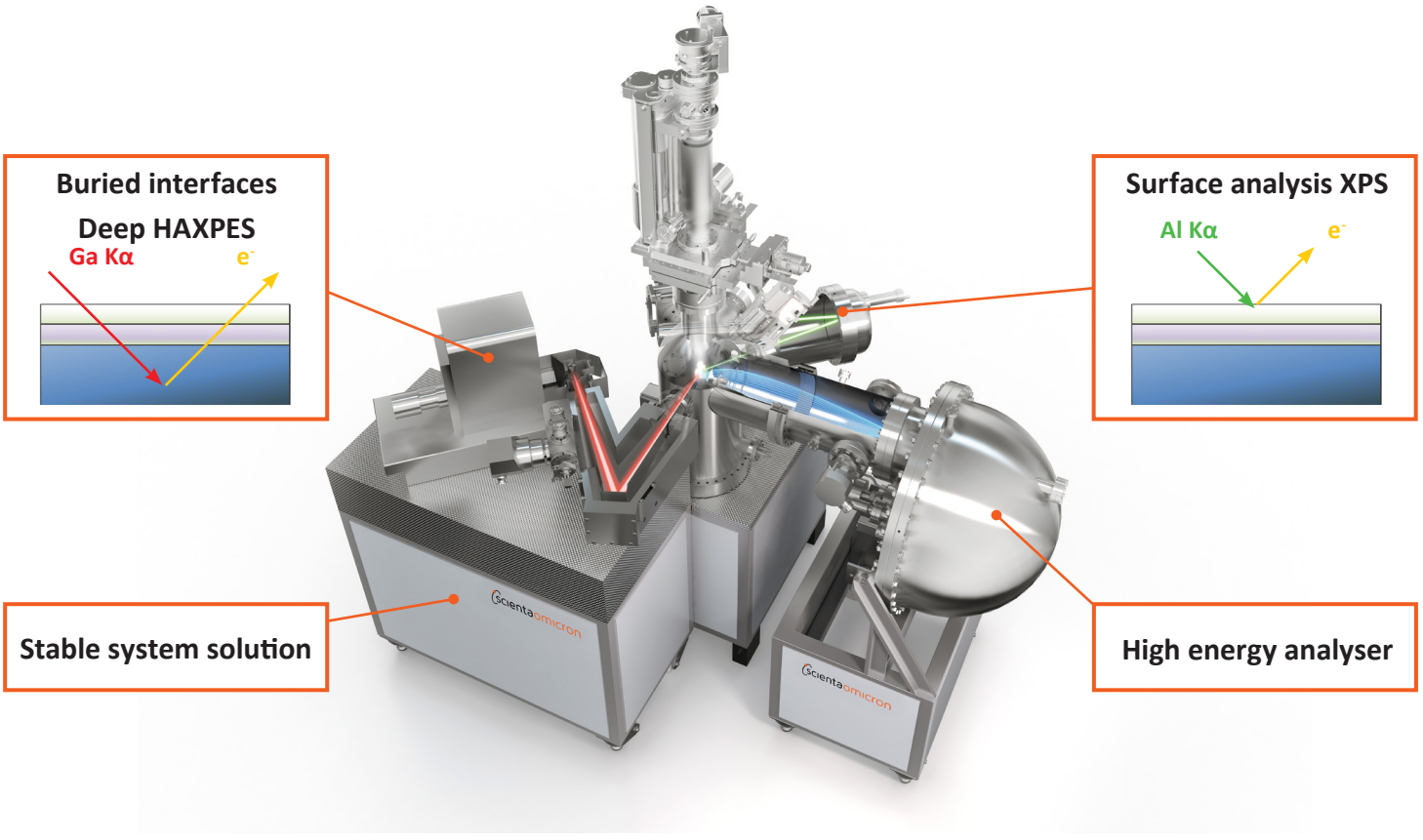
White paper

ADVANCING GAA TECHNOLOGY: The Technical Edge of Deep HAXPES

HAXPES Lab for Industry



Advancing GAA Technology: The Technical Edge of Deep HAXPES

1. Introduction

Gate All Around (GAA[1]) Technology: A Paradigm Shift in Silicon Chip Production:
Gate All Around (GAA) technology represents a significant leap in the evolution of silicon chip production, promising higher density, and enhanced performance. This innovative approach enables the fabrication of transistors with a gate encircling the channel from all sides, allowing for unprecedented control over the channel and significantly reducing leakage currents. The GAA technology marks a major advancement in the semiconductor industry, paving the way for more efficient, powerful, and miniaturized electronic devices. Its development not only symbolizes a technical breakthrough but also opens new horizons in the realm of high-performance computing and consumer electronics, setting a new benchmark for future silicon chip technologies.

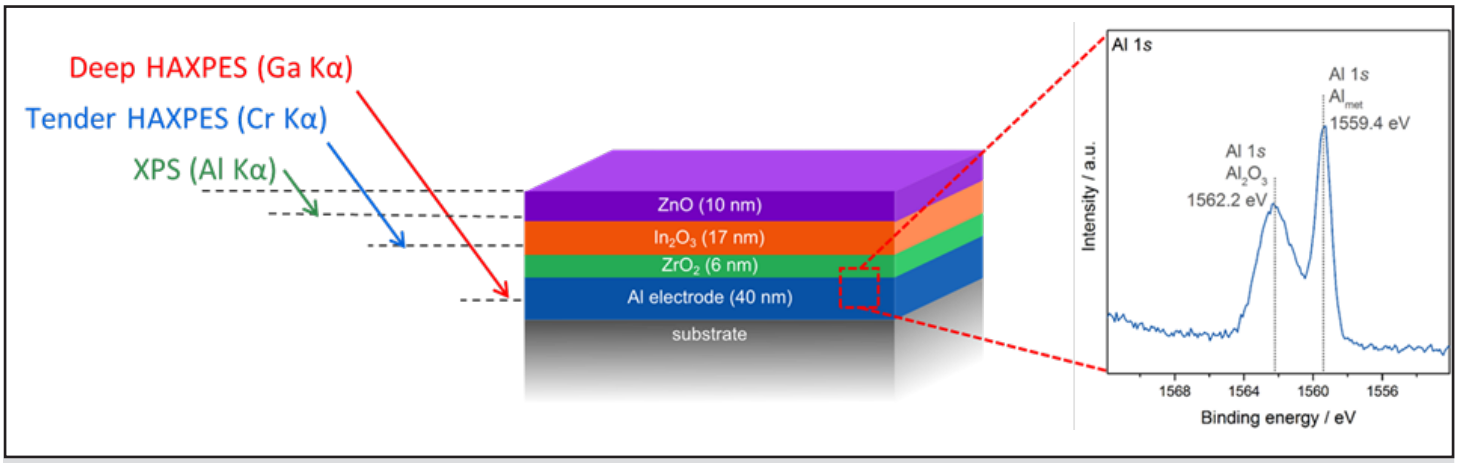
Introduction to HAXPES and Its Relevance to R&D:
Hard X-ray Photoelectron Spectroscopy (HAXPES) has emerged as a pivotal tool in material science research and development. Scienta Omicron has developed a unique Deep HAXPES tool that provides new insights into material properties, enabling breakthroughs in semiconductor research, and more.

Principle of Operation and Key Features of HAXPES Technology:
HAXPES operates by irradiating materials with hard X-rays and analyzing the energy and angular distribution of emitted electrons. This results in detailed information about the electronic structure, chemical composition, and oxidation state within materials. Key features distinguishing Deep HAXPES from standard XPS include access to 50 nm deep, buried interfaces through non-destructive depth profiling.

2. HAXPES in Semiconductor Research

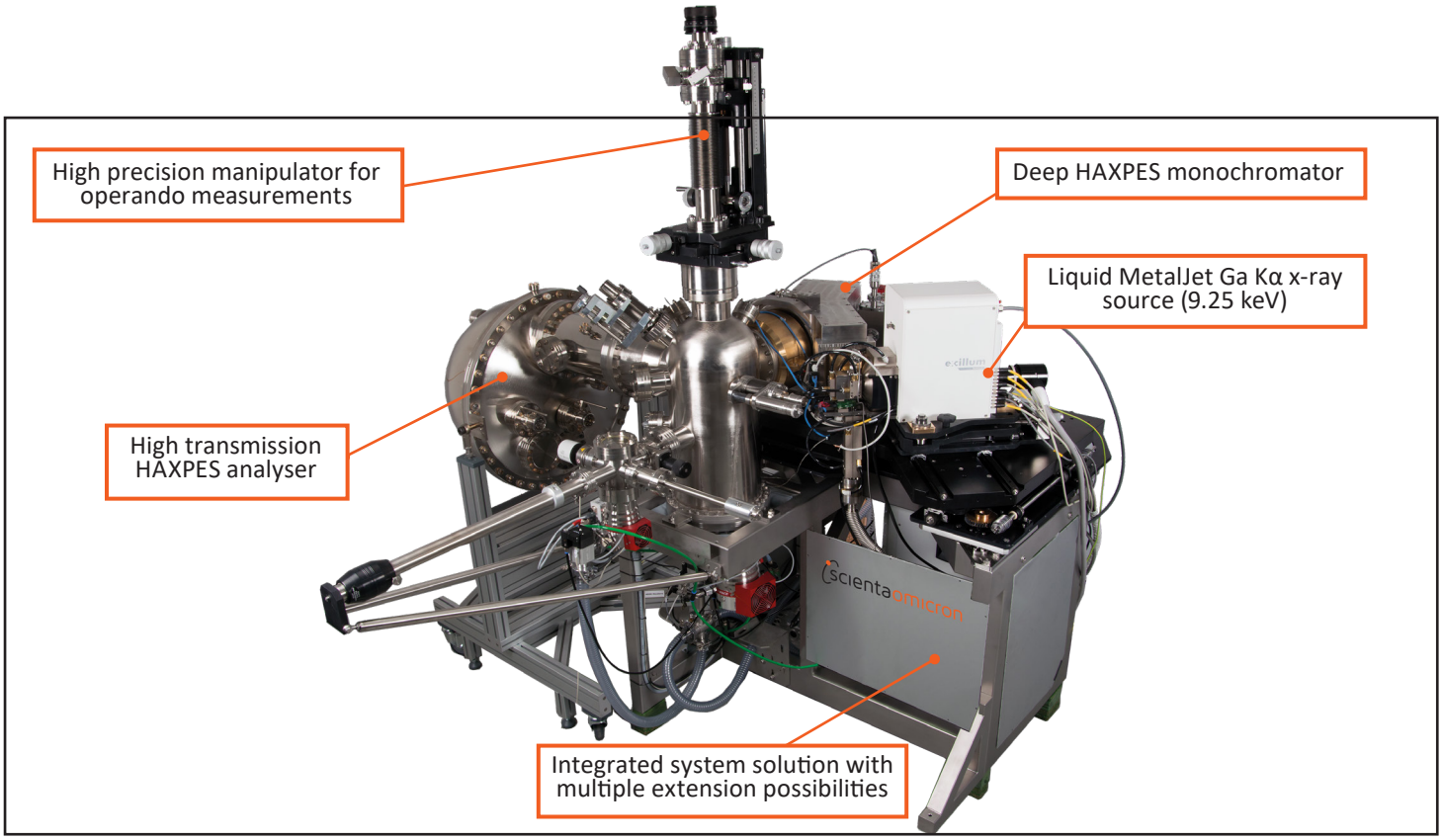
Scienta Omicron is actively compiling case studies relevant to HAXPES use in GAA applications. We are examining applications in Research, QTM (Quick Term Monitoring), and Production.

Practical Applications of HAXPES in Industrial R&D Settings:
In industrial R&D settings, HAXPES is a significant change for advancing GAA technology. Its non-destructive analysis and depth profiling capabilities enable precise material characterization, essential for fine-tuning semiconductor manufacturing processes. HAXPES aids in optimizing gate oxide interfaces, crucial for GAA transistors, thereby enhancing the overall performance and reliability of the final semiconductor products. Capabilities of Operando measurements include both temperature and bias-applied Deep HAXPES. This combined translates into more efficient production processes, higher yields, and the development of superior semiconductor devices.



Multi-oxide heterostructure, used in transistor stacks and diodes. Rev. Sci. Instrum. 89, 073105 (2018)

[1] In the term GAA we are including GTAA FET, RibbonFET, MBCFET



3. Scienta Omicron's Strategic Initiatives

Overview of Scienta Omicron's Strategic Planning and Market Approach:
Scienta Omicron has strategically positioned itself as a leader in the field of advanced surface science instrumentation, including HAXPES technology. Our approach focuses on continuous innovation, collaboration with academic and industrial research communities, and an emphasis on addressing the evolving needs of the semiconductor industry. This approach ensures that our products, particularly those related to GAA technology, remain at the forefront of technological advancements, and meet the stringent requirements of modern semiconductor R&D.

Future Directions and Goals for HAXPES Technology:
Looking forward, Scienta Omicron is committed to further advancing HAXPES technology. Our goals include enhancing the resolution and sensitivity of our instruments, expanding the range of applications, and developing more user-friendly interfaces. These advancements are aimed at unlocking new insights into material properties, which are critical for the development of innovative technologies like GAA and CFET.

Conclusion:
Scienta Omicron's strategic initiatives in developing and refining HAXPES technology significantly contribute to the semiconductor industry, particularly in the research and development of Gate All Around technology. Our commitment to innovation and understanding industry needs positions us as a key partner in driving forward the next generation of semiconductor technologies.

Contact us!
We are looking forward to discussing your scientific challenges and needs to establish how HAXPES Lab can be of service.

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Accelerating Materials Innovation

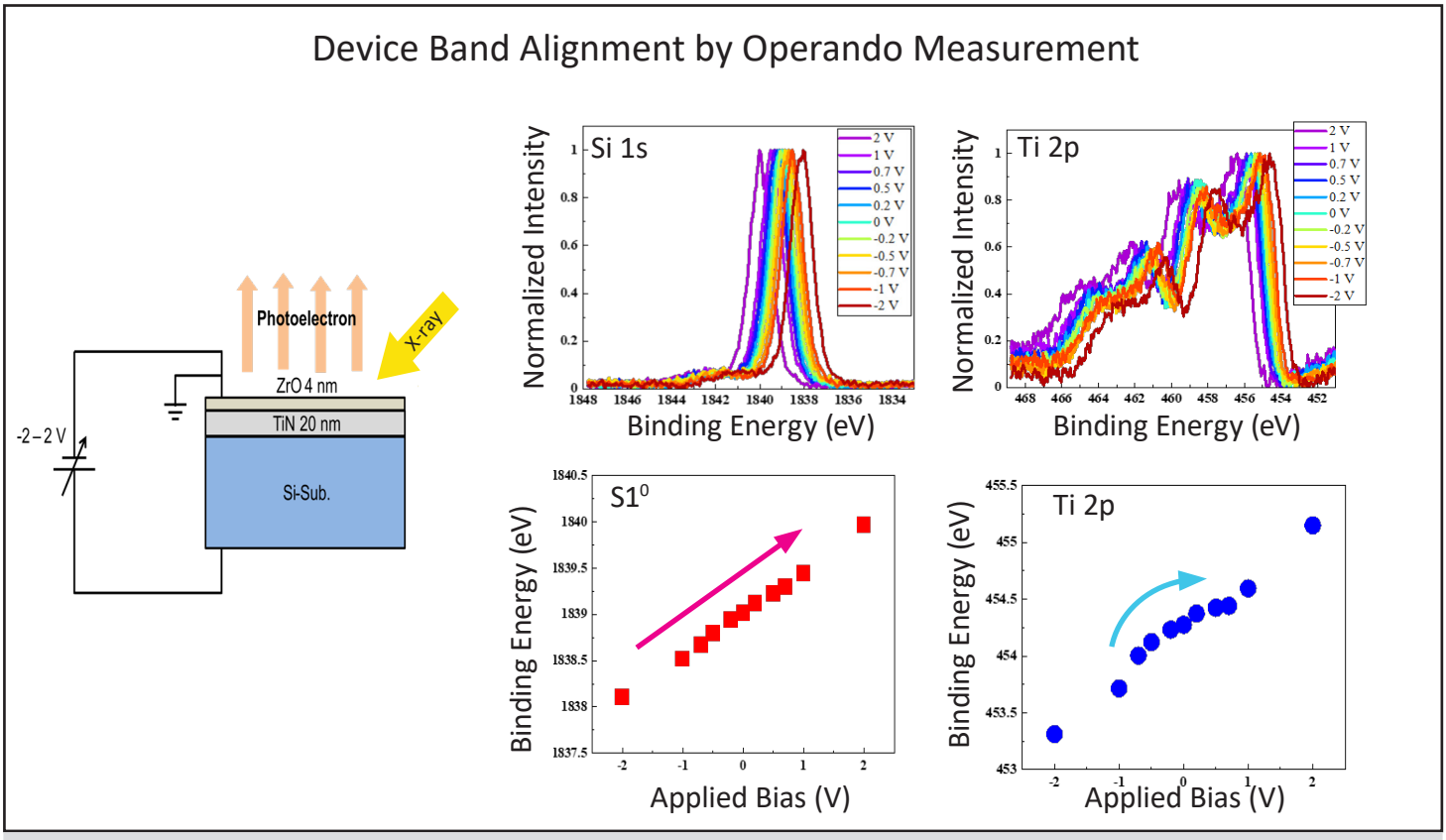
About HAXPES Lab

Scienta Omicron's HAXPES Lab brings deep hard X-ray photoelectron spectroscopy (D-HAXPES) capability directly to the local laboratory environment. Using world class technology and expert engineering, the instrument sets the standard for laboratory based HAXPES. This novel system probes bulk sample properties in operando conditions, and accesses deep core level electrons, previously only reserved for synchrotrons.

About Scienta Omicron

Scienta Omicron is a leading innovator in surface science and nanotechnology. We provide top capabilities in electron spectroscopy, scanning probe microscopy and thin film deposition, all in ultra-high vacuum (UHV). Focusing on the race for new unique materials and solutions, in areas like – smarter batteries, next generation electronics, quantum technologies, solar energy, intelligent sensors and advanced materials, Scienta Omicron drives surface science research towards the future.

When you invest in Scienta Omicron instruments, you invest in Nobel Prize technologies, as our roots trace back to Nobel laureate Kai Siegbahn (1981) as well as, Gerd Bining and Heinrich Rohrer (1986). Scienta Omicron was formed in 2015 through the merger of VG Scienta and Omicron NanoTechnology.



Bias applied operando HAXPES for voltage distributions acress sample layers and interfaces. *Courtesy of HAXPES Lab at the semiconductor Nanotechnology Lab, Meiji University, Japan*

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